

1 I Claim:

2 1. A surface and subsurface operational watercraft having an elongated body  
3 with a forward end and a rearward end, said watercraft being further characterized in  
4 having:

5  
6 a) A weight and a power means;

7  
8 b) Said body having a planview with a narrow portion adjacent said forward end and  
9 a broader portion adjacent said stern;

10  
11 c) Said body having right and left lateral wings;

12  
13 d) Said vessel being capable of operating in, at and below the surface of water;

14  
15 e) Said vessel when floating static in water having a first submerged volume  
16 generating an upward buoyant force equal to the weight of said vessel and a  
17 second volume above said first volume sufficient to permit surface operation of said  
18 vehicle with a significant positive reserve buoyancy margin;

19  
20 f) Said vessel being capable of moving forward in water under the action of said  
21 power means in an efficient and sustained manner;

22  
23 g) Said wings being at least partially submerged when said vessel is operating at the  
24 surface of water at a dive speed;

25  
26 h) Said wings at said dive speed operative to generate a downward hydrodynamic  
27 force sufficient to overcome the upward buoyant force of said reserve buoyance  
28 margin when submerged;

1  
2 i) Said wings at a submerged speed operative to generate a downward hydrodynamic  
3 force sufficient to counter the lifting forces generated by said second volume when  
4 submerged;

5  
6 j) Whereby said vessel can operate submerged in an efficient and sustained manner.  
7

8 2. The watercraft of claim 1 wherein said wings are adapted to move with their  
9 trailing edge upwards to submerge said watercraft at said dive speed and retain the  
10 submerged condition at a submerged speed.

11  
12 3. The watercraft of claim 1 in which said wings have movable trailing edge flaps  
13 which are adapted to move upwards to generate a downward hydrodynamic force and  
14 downwards to generate a lifting force.  
15

16 4. The watercraft of claim 1 in which:  
17

18 a) Said broader portion adjacent said stern has a broad beam in planview forming the  
19 trailing edge of said elongated body;  
20

21 b) In that the profile shape of said broader portion tapers in side view smoothly in a  
22 rearward direction with upper and lower surface portions meeting at said trailing  
23 edge.  
24

25 5. The watercraft of claim 4 in which said elongated body has a generally  
26 triangular planform.  
27

28 6. The watercraft of claim 4 further comprising a movable flap mounted on said

1 trailing edge, adapted to be moved downwards to dive and/or pitch down said watercraft,  
2 and upwards to climb towards the water surface and/or pitch up said watercraft.

3  
4 7. The watercraft of claim 4 in which the span of said flap is approximately equal  
5 to the beam at the trailing edge of said elongated body.

6  
7 8. The watercraft of claim 7 with the chord of said flap being no less than  
8 approximately 2.5% of the length of said elongated body.

9  
10 9. The watercraft of claim 1 in which said wings are located adjacent the  
11 midbody portion of said vehicle between said forward and rearward ends.

12  
13 10. The watercraft of claim 1 in which the angle of incidence of said wings  
14 relative to said elongated body is adjustable symmetrically up and down to cause upward  
15 and downward forces on said watercraft.

16  
17 11. The watercraft of claim 10 in which said right and left wings are adjustable  
18 to have angular motion asymmetrically, to cause asymmetric forces that tend to roll said  
19 vessel.

20  
21 12. The watercraft of claim 1 in which, when operating said vehicle at speed on  
22 the surface of water, at least a portion of said wings are adapted to be permanently  
23 immersed in water to generate upward forces and to raise the elevation of said watercraft  
24 and reduce said first submerged volume, whereby drag is reduced.

25  
26 13. The watercraft of claim 5 in which said trailing edge flaps on said elongated  
27 body and said wings are adapted to be moved in coordinated fashion to accomplish pitch  
28 and path control, with the trailing edge of said flap of said elongated body moving in

1 opposite direction to the trailing edges of said wings.

2  
3 14. The watercraft of claim 6 in which the trailing edge of said flap and said wings  
4 are adapted to be moved in the same direction to accomplish changes in heave.

5  
6 15. The watercraft of claim 1 in which said second volume is at least  
7 approximately 50% of said first volume.

8  
9 16. The watercraft of claim 1 in which the area of said wings is no less than the  
10 area obtained by dividing a quantity equal to approximately the buoyant force on said  
11 second volume when submerged by the product of the dynamic water pressure in said  
12 submerged motion times a non-dimensional number no less than approximately 0.4 and  
13 no greater than approximately.

14  
15 17. The watercraft of claim 1 in which the planform of said elongated body is  
16 generally triangular with a narrow end forward.

17  
18 18. The watercraft of claim 17 in which the profile of the submerged portion of  
19 said elongated body in side view when floating in static condition is generally a long triangle  
20 with base adjacent said forward end and apex adjacent said rearward end.

21  
22 19. The watercraft of claim 15 in which the profile view of a portion of said  
23 elongated body above water level is approximately triangular with long base at waterplane  
24 and opposite sides upwards.

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1        20.    A surface and subsurface operational watercraft having an elongated body  
2 with a forward end which is approximately wedge-shaped in planview with narrow end  
3 forward, and rearward end which is approximately wedge-shaped in profile view with  
4 narrow end rearward,

5  
6        21.    The watercraft of claim 20 in which lateral right and left wings are mounted  
7 on said elongated body approximately adjacent the midbody portion of said elongated  
8 body.

9  
10       22.    The watercraft of Claim 20 in which a movable control surface is mounted on  
11 the trailing edge of said rearward end.

12  
13       23.    The watercraft of Claim 20 in which the included angle in profile of said  
14 rearward end is approximately twice the included angle in planview of said forward end.

15  
16       24.    The watercraft of Claim 20 in which said watercraft, when on the water  
17 surface, the included angle in profile between the water surface and the lower surface of  
18 said rearward end is approximately equal to the included angle in planview of said forward  
19 end.

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1           25.    A surface and subsurface operational watercraft comprising:

2  
3 a watercraft hull including;

4  
5 a generally triangular water-engaging section including a pointed bow, horizontally  
6 extended stern and generally straight side walls extending divergently from said bow  
7 to said stern; and

8  
9 a generally pyramidal surface section atop said water engaging section having left and  
10 right forward wall sections each respectively extending from and engaging the upper  
11 edges of one of said side walls and a rear wall section extending upwards from said  
12 stern; and

13  
14 at least two attitude-adjustable water-engaging wings each mounted on and extending  
15 outwards from a respective one of said side walls of said water-engaging section,  
16 said wings operative to control submersion of said watercraft during movement of  
17 said watercraft via attitude adjustment thereof.  
18

19           26.    The watercraft of claim 25 wherein said bow has a substantially deeper draft  
20 than said stern.  
21  
22  
23  
24  
25  
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1        27.     A watercraft capable of operation above and below water surface having a  
2 bow and a stern, characterized in having:

- 3
- 4     a)     An elongated body having an approximately triangular planform shape with its apex  
5           towards the bow;
- 6
- 7     b)     An elongated shape in profile with a deeper draft towards the bow and a shallow  
8           draft towards the stern;
- 9
- 10    c)     A static waterplane level; and
- 11    d)     A vehicle weight.

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14        28.     The watercraft of claim 27 wherein

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- 16    a)     The weight of the volume displaced by the watercraft when fully submerged is  
17           substantially larger than the weight of the watercraft.
- 18
- 19    b)     Right and left wings are provided extending laterally outboard of the sides of said  
20           elongated body when said watercraft has forward motion at said water surface, said  
21           wings being capable of providing a downward force at least approximately equal to  
22           the difference between said water weight and the weight of said vessel.
- 23
- 24    c)     With said wings continuing to provide said downward force for continuous  
25           submerged operation.
- 26

27        29.     The watercraft of claim 28 wherein the water weight of the volume displaced  
28 by the vessel is substantially larger than the weight of the vessel.

1        30.    The watercraft of claim 29 further characterized in that a traverse trailing  
2 edge flap is provided adjacent the base of said triangular planform, with said flap being  
3 deflected trailing edge down when operating at the surface to cause said vessel to  
4 submerge, and deflected trailing edge up when operating submerged to cause said vessel  
5 to surface.

6  
7        31.    The watercraft of claim 30 further characterized in having a powerplant and  
8 in that for a given position of wings and flap when operating submerged, depth control  
9 below water is controlled in steady submerged navigation by changes in power level of said  
10 powerplant.

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12        32.    The watercraft of claim 22 further characterized in having:  
13  
14 an overall streamlined external surface envelope of said elongated body with a total body  
15 volume;  
16  
17 a primary interior dry volume having a structural midbody portion capable of supporting  
18 external water pressures when submerged; and  
19  
20 a secondary internal volume adjacent said ends which is adapted to be flooded during  
21 submerged operation to equalize pressures between water outside and inside said  
22 external envelope in said secondary volume.

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24        33.    The watercraft of claim 20 further characterized in that said vessel is adapted  
25 to be air-dropped from an aircraft, with a parachute establishing a decent rate for head-on  
26 entry into a water body.

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28        34.    The watercraft of claim 20 further characterized in that said vessel is adapted



1 for land operation having a tricycle wheel arrangement.

2  
3 35. The watercraft of claim 20 further characterized in that said vessel is adapted  
4 to move relative to a large wave by a transient submerged motion and path below said  
5 wave.

1           36.    A watercraft capable of operating at surface and subsurface conditions  
2 characterized in having:

3  
4 an elongated central body with a longitudinal length;

5  
6 wings mounted on said body having a hydrodynamic wing force center when in motion;

7  
8 a first center of buoyance when floating in surface conditions;

9  
10 a second center of buoyance when in submerged condition.

11  
12           37.    The watercraft of claim 36 wherein said center of buoyancy and said  
13 hydrodynamic wing force center are ahead of said first center of buoyance, and that a  
14 downward hydrodynamic force on said hydrodynamic wings is additive to the gravitational  
15 weight force of said vehicle and jointly oppose and tend to equilibrate the total buoyant  
16 forces of the water acting on said second buoyancy center.

17  
18           38.    The watercraft of claim 20 further characterized in that said elongated body  
19 has an upper body portion above water level when operating at surface, said upper body  
20 portion having an approximately triangular planform, and an approximately triangular profile  
21 in side view to reduce radar reflection.

22  
23           39.    The watercraft of claim 38 wherein said triangular profile in side view is  
24 modified to be polygonal above the water plane, with the outer surfaces of said upper body  
25 portion being faceted between planview and profile.

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